Ball Targeting System with Positive Feedback

by CATEA on September 9, 2010

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Intro: Ball Targeting System with Positive Feedback

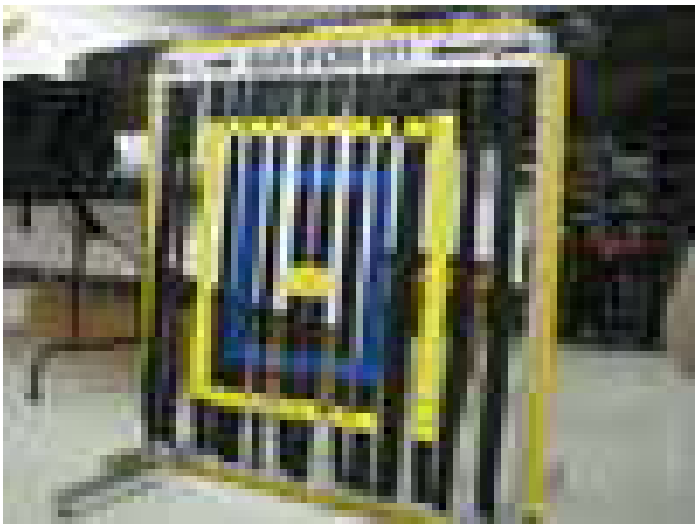
Instructions for making a portable variable impact ball targeting system with light and audio feedback

Problem Statement

The cREATe target was created specifically for an Adapted Physical Education teacher, Mr. David Martinez and his students. The target needed to be able to provide sufficient audio and visual feedback to stimulate the senses of his students of all ages while also being large enough to allow multiple functions for Mr. Martinez to use the target with the students. The target also needed a way to hang upright on a pull up bar, bleachers, or basketball hoop. However, because Mr. Martinez travels frequently by car from school to school, the target had to be lightweight and small enough, without sacrificing the size of the target, to carry and fit inside of his jeep. The target also needed to have power supply.

Resolution

The cREATe students designed a target with LED emitter/detector sensors and eventually used 31” IR distance sensors that were connected in circuit withIkea Diode Light Strips and an MP3 trigger. These IR triggers sensed when the IR beam was broken and activated a timer and a random number generator that switched on the lights and music for ten seconds. The frame was made out of 80/20 1010 T-slotted Aluminum Extrusions because it was light but sturdy. The dimension of the frame was 34” x 36” which was just large enough so that the 31” distance sensors only needed to be placed on one side of the target since the balls were larger than the 3” dead spot distance.



step 1: Materials Needed:

Frame
Part (part #, amount, size)
1010 T-slotted Aluminum Extrusions (1010, 4, 36 inches)
Economy T-nuts (3275, 4, N/A)
Double Economy T-nuts (3281, 4, N/A)
Button Head Socket Cap Screw (3063, 60, N/A)
80/20 Four Hole Joining Plate (4150, 2, N/A)
2 Hole Standard Transition Inside Corner Bracket (3321, 2, N/A)
Outer Protection Cart Guard Covers (2857, 1, 160 inches)
Cart Guard Bolting Kits (3486, 25, N/A)
Cart Guard Mounting Base (2854, 1, 160 inches)
Cart Guard Corners (2867, 4, N/A)
Carabiner (2, N/A, N/A)
All purpose rope (2, N/A, N/A)
Hook assortment pack (4, N/A, N/A)

Detection
Part (amount, link)
Sharp GP2Y0D02YK IR Sensor - 31" Trigger (2, www.hobbyengineering.com/H1760.html)
Cable for Sharp 3-Pin IR Sensors for Breadboarding (2, www.hobbyengineering.com/H1183.html)
Housing for sensor (2, N/A)
Button Head Socket Cap Screw (4, N/A)
Double Economy T-nuts (2, N/A)

Shroud
Part (amount, part #, size)
1.75" Seat belt (14, N/A, 35.5 inches)
Electrical Tape (optional for design)
Economy T-nuts (12, 3275, N/A)
Double Economy T-nuts (2, 3281, N/A)
Button Head Socket Cap Screw (16, 3063, N/A)

Electronics

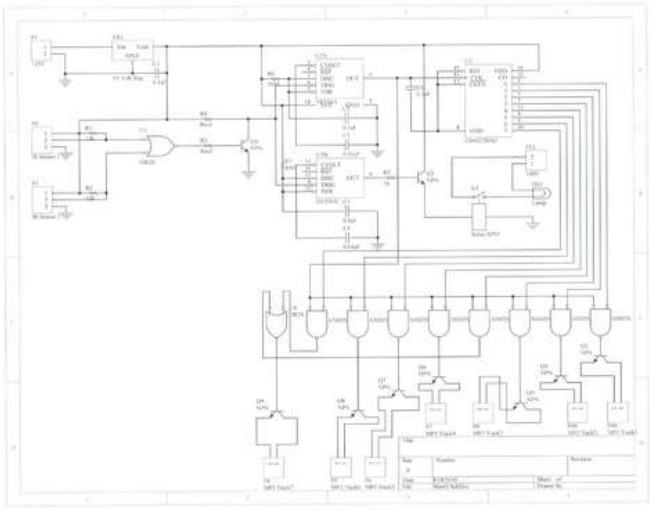
• MP3 Trigger (1x, www.sparkfun.com/commerce/product_info.php?products_id=9715) Estimated $49.95
• Circuit Board (RadioShack – 2x Dual General-Purpose IC PC Board Model: 276-159, 1x Multipurpose PC Board with 417 Holes Model: 276-150, $1.99 ea.)
• Micro SD Card (1x, N/A)
• Dioder Lighting Strip (2x, www.ikea.com/us/en/catalog/products/50119407) Estimated $40.00
• 12 V Transformer (1x, N/A)
• Resistors (12 kOhm, 40 mOhm, 300 Ohm, 1kOhm, 10MOhm)
• Capacitors (0.01 uF, 0.1 uF)
• Transistors (NPN) 9x, (less than $1/ each)
• Dual Timer Estimated (LM 556) ($0.68 - $1/ each)
• Logic OR gate (HD7432) 1x ($0.60/ each)
• Logic AND gate (SN5408) 2x,
• Octal Counter (CD4022B) 1x ($0.99/ each)
• Relay (capable of switching 115V AC) 1x
• 5V Voltage Regulator 1x
• IR Sensor (2x, Sharp, $16.99/ each) (www.hobbyengineering.com/H1760.html)

Legs
Part (amount, part #)
0 Degree Pivot Nub (4, 4187)
6 Hole Joining Plate (2, 3321)
1010 T-slotted Aluminum Extrusions (4, 1010)

step 2: Assemble circuit

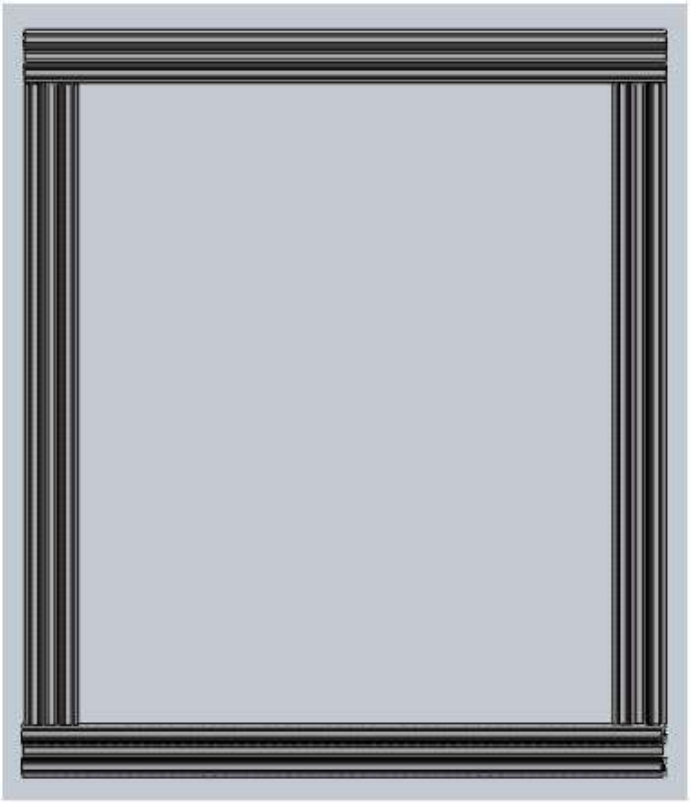
The circuitry of the ball target device is designed to detect objects (ball) that pass through the target area and to generate a 5V trigger pulse, which activates two separate timer circuits (2s and 6s length). To detect an object, 2 IR sensors (Sharp) have been installed, both of them featuring an IR emitter and receiver. Both sensor outputs feed into a dual input OR gate, to assure that a) they don't interfere with their signals and b) in the event of activating any of the sensors (or both), a single 5V trigger pulse (TTL) will be generated. Both of the timer circuits are triggered with the falling edge of the input signal. The transistor Q1 (schematic) will pull down the voltage (5V) at the inputs of the timers and create a falling edge at the event of a detected object. The 1st timer (U2A – schematic) will output a 2s signal, which feeds into the counter and into one each of the inputs of the 8 dual input AND gates. The counter will count 1 up and activate the selected output. Since the output of the counter (once activated) will stay on "high" until the next counting pulse, each output feeds into a dual AND gate. This bears the advantage, that together with the timing pulse of 2s, the output of the activated AND gate will only be high for max. 2s. If the counter outputs would feed directly into the MP3 module, the module would play songs in a constant loop. Since the MP3 module has only 7 inputs for hardware control, 2 of the counter outputs (3 & 7 in this case) feed into a dual input OR gate (same IC used for the sensors) and from there to the MP3 module. The 2nd timer incorporates a larger resistor, which increases the length of the generated signal to about 6s. This signal activates a SPST relay, which turns on the IKEA diode strips as the visual feedback part of the system.

See circuit diagram for details.



step 3: Assemble target frame

Cut 1010 T-slotted Aluminum Extrusions into four bars that are 36" in length. Align the bars so that the outside vertical height is 38" while the outside horizontal length is 36". The inside vertical height should be 36" with an inside horizontal length of 34". See diagram.

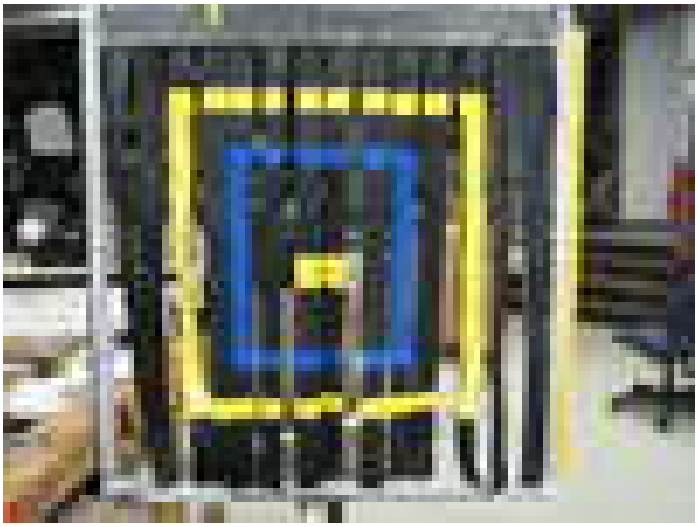


step 4: Attach joining plates to frame

Attach a four hole joining plate to the two top corners of the frame and securely screw into place. Attach two 2 hole standard transition inside corner brackets to the bottom corners of the frame and screw into place.

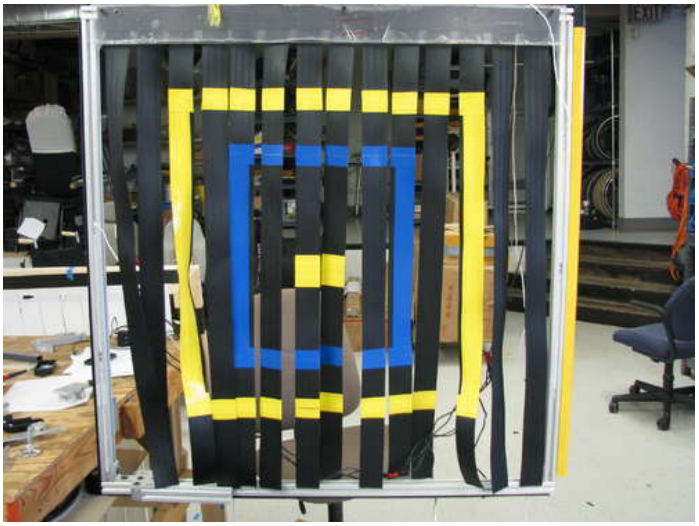
step 5: Assemble target shroud

Cut fourteen pieces of 1.75” seat belt material that are 35” in length (other material can be used); cut another piece of seat belt material approximately 34" in length and vertically align the fourteen seat belts to the horizontal seat belt and sew horizontally across the horizontal seat belt to get an even line. The vertical seat belts were placed 1" from the bottom of the horizontal seat belt.



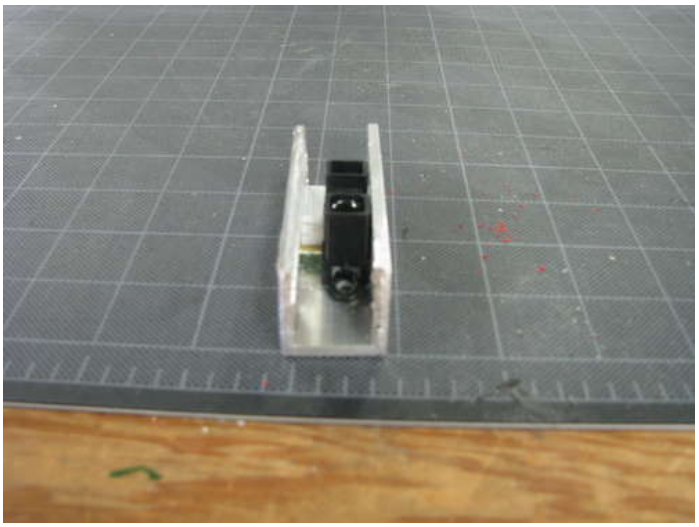
step 6: Attach shroud to target

Use a fabric hole puncher to create holes in the seat belt material consistent with the spacing of the economy T-nuts in order to screw the fabric into the 80/20 frame. Then, attach the shroud to the target with economy T-nuts and screws across the horizontal seat belt with the attached vertical straps– use the two hole washers for the ends for more support and use the one hole washers that are equally spaced across the middle of the horizontal seat belt material.



step 7: Assemble housing for IR sensors

Create IR sensor housing out of 1x1" square aluminum that has one open side. Drill holes for both the sensor and the mounting screws. The hole for the wire was 7/16" and the holes for screwing to the side of the frame were 3/8". See example.



step 8: Attach housing for IR sensors to frame

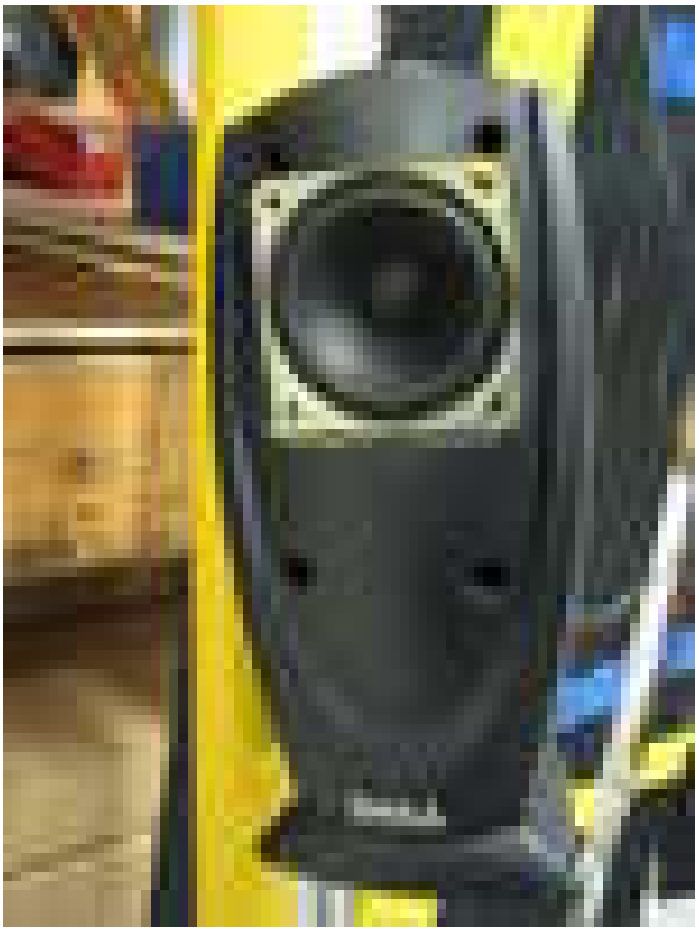
Screw the housing of the IR sensors directly to the frame of the target using screws, a double economy T-nut, and washers. See example.

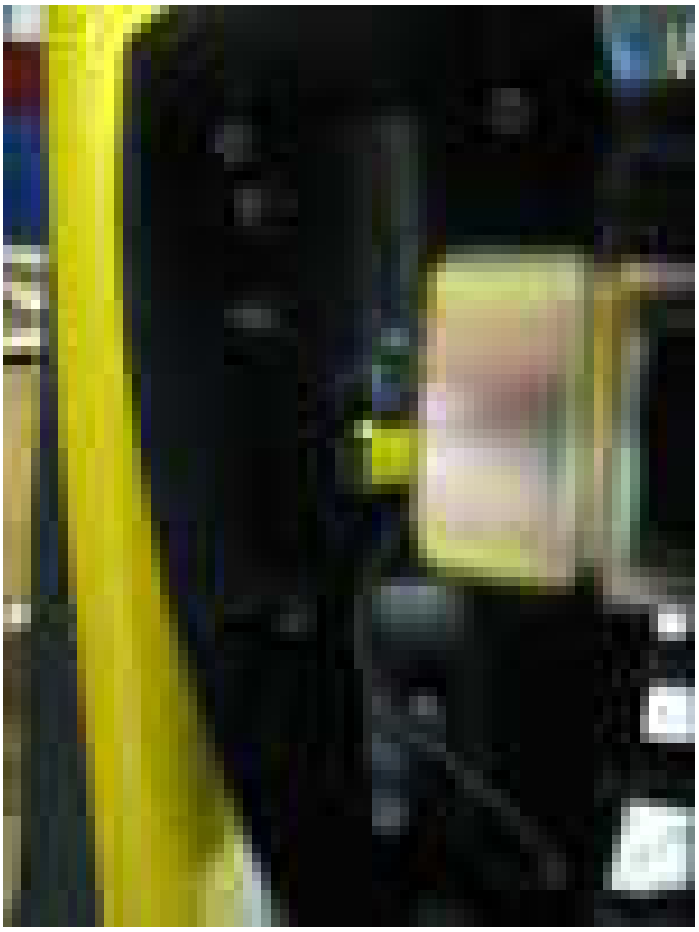
step 9: Mount lights

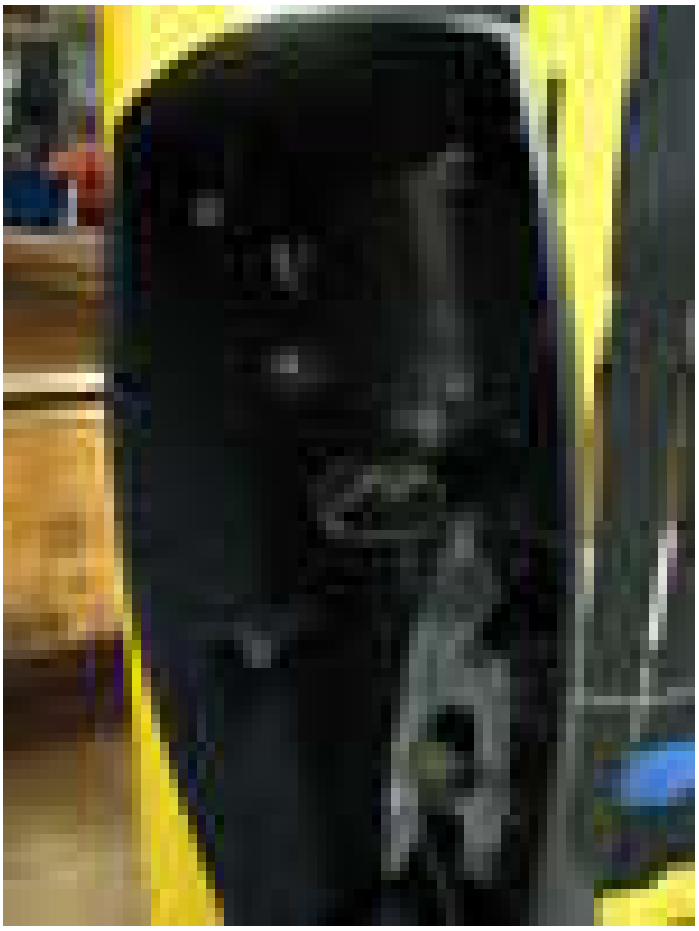
Slide the Ikea Diode Light Strip into crevice in the front of the 80/20 frame. The light strip will fit snugly but can be secured with glue or tape if necessary.

step 10: Mount speakers

We used Dell computer speakers for this application. Before attaching the speakers we removed the face of the speaker in order to access its rear casing. Here we drilled two holes in order to mount the screws inside the speaker that will eventually attach the speaker to the frame. Once the holes are drilled, screw the speaker directly into 80/20. Finally, reattach the speaker face or make housing for the speaker and screw the housing into 80/20.





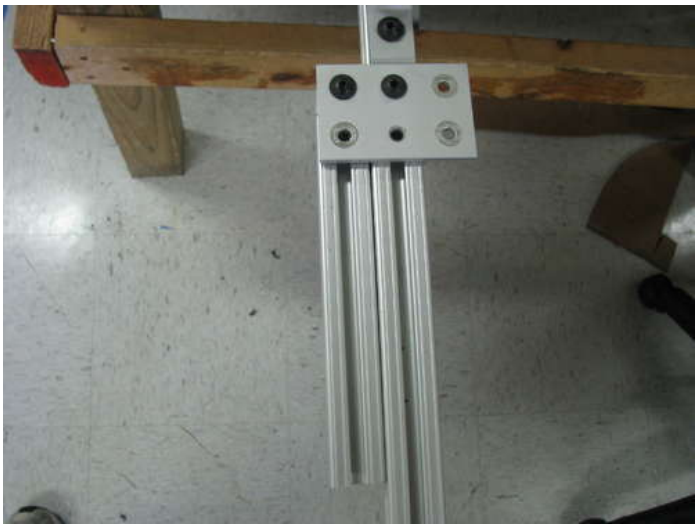


step 11: Attach hanging eye bolts

Screw eye bolts directly to the top of the frame approximately 3.5" from the edge of the frame on each side. All purpose rope was tied to the carabiners and the carabiners were hooked onto the eye bolts. The other side of the rope was attached to a hook for hanging.

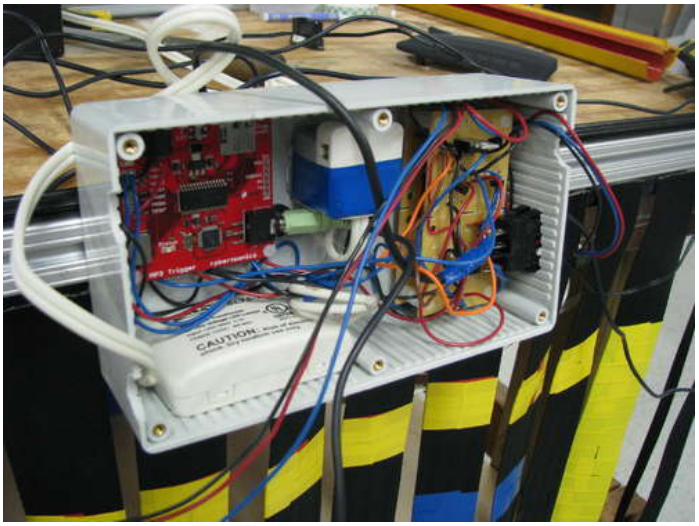
step 12: Attach legs onto frame

Attach 6 hole joining plate to the bottom leg of the target. The joining plate should be aligned so that the two holes protrude from each side of the target. Screw the middle portion into the target frame itself. Cut four 1010 T-slotted extrusions into 14.5" pieces. Screw a 0 degree pivot nub to one end of each of these legs. Screw the 0 degree pivot nub into the outer hole of the 6 hole joining plate.



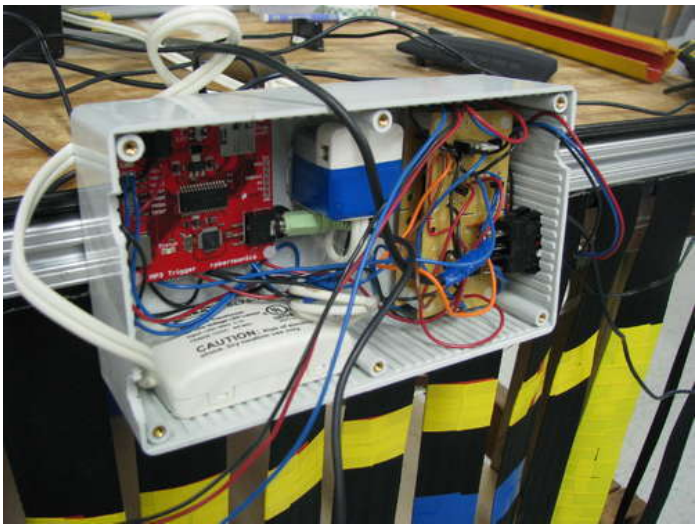
step 13: Assemble circuit into housing

The circuit will be housed in a project box capable of holding the circuit in place. The circuit was taped or glued down securely so wires would not detach from the circuit board.



step 14: Attach circuit housing onto frame

Screw the circuit housing directly to the back of the 80/20 frame using screws, washers, and two economy T-nuts. The housing should be placed on the top middle portion of the frame in order for all of the wires to run to the housing case.



step 15: Attach outer covering

The cart guard mounting base was cut into 4 pieces – two pieces 36 inches in length and two 35 inches in length. The longer pieces were attached to the vertical sides of the target and the shorter pieces were attached to the vertical sides. The outer protection cart guards were cut into two pieces 33 inches in length and the other two into 34 inches in length. The cart guard corners slid into the cart guard mounting base and the protection guards slid into the corner guards to keep them in place. The wires from the speakers and the lights can be protected and placed between the mounting base and the outer protection cart guards.

Related Instructables

How to throw a Rugby ball by murph8868

How to properly strike a soccer ball by FrozenPhyre

Knife Throwing by die_dunkelheit

How to play baseball by Easy Button

How to make an autonomous basketball playing robot using an iRobot Create as a base by Matthew Oelke

Rugby for Beginners by irishrugbysparta

Comments

5 comments **Add Comment**

Dave Martinez, CAPE says: Sep 22, 2010. 6:00 PM **REPLY**

I am very grateful to the CAETA lab and cREATe students of Georgia Tech for designing and building a very effective piece of equipment for my students with various disabilities. As an adapted physical educator, I need to individualize instruction and frequently modify equipment that allow for successful physical education experiences.

What makes this piece of equipment unique is the positive and immediate feedback it provides my student with when they are successful. For example, when a student kicks a ball through the target, it will immediately light up and play popular songs (or positive sound effects). I have the ability to add or remove songs and/or sound effects from the MP3 player by simply accessing the SD card (how innovative and useful). This is a great feature because it allows me to add meaningful audio feedback specific to the student using the device. When my students' motivation levels are high they are more likely to stay on task and repeat a skill multiple times.

Another great feature is the target's ability to be wall mounted at various heights or free standing on the floor. If mounted on the wall, students can practice a variety of throwing skills while using various objects (e.g., tennis balls, foam balls, foam footballs, Frisbees, etc.). I have also successfully used the device with my Special Olympians to practice their tennis striking skills.

When mounted on the floor my students can reinforce their ramp rolling skills (sport skill specific to ramp bowling), kicking skills, hockey striking skills, etc. Finally, the device fits nicely in the back of my Jeep Patriot. The CATEA Lab even equipped it with a handy carrying strap. This is a nice feature because I travel to several schools a day.

Submitted by:
Dave Martinez, CAPE

Nationally Certified Adapted Physical Educator and Special Olympics Coordinator – Cherokee County, GA

EnigmaMax says: Sep 16, 2010. 7:56 PM **REPLY**

Very, very nice. I originally thought this was constituted for football, but this can work for soccer, golf, and baseball too.

CATEA says: Sep 17, 2010. 7:09 AM **REPLY**

Thank you,

We designed this especially for throwing and kicking practice. It goes with any sports that involve trowing and kicking. Music will motivate kids to try again and again.

steveastrouk says: Sep 18, 2010. 4:01 AM **REPLY**

Karate ?

fungus amungus says: Sep 17, 2010. 8:47 AM **REPLY**

This is a very cool project with detailed instructions, but I think a video of it in action would go a long way in showing how it works. Pretty please?